FINAL TERM EXAM:

SUBMITTED TO:-

Engr. M. SAQIB

SUBMITTED By:-

M. ILYAS

Roll No:

7956

SECTION:-

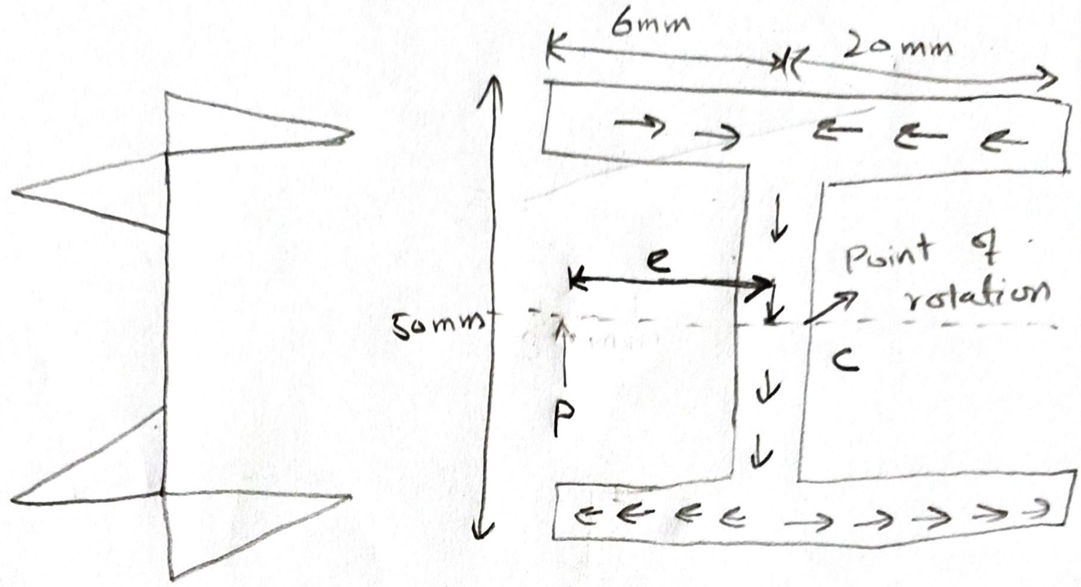
B

Paper:

MOS-II

Deparment:- Civil ENGG.

Q : No: 01 Part(a) CLO : 2



→ The section is symmetrical about x-axis & not y-axis

So, any external force on section will creat twisting in the section.

So in order to avoid twisting we will find out plane where external load will balance, the internal shear flow in the section.

→ As the section is symmetrical only about x-axis the shear center must lies somewhere on x-axis

→ Clockwise moment = Anticlockwise moment

$$V \times e + f_f \times 50$$
$$= F_f \times 50$$

$$e = \frac{F_f \times 50 - f_f \times 50}{V}$$

Now we will find out I_x and y

$$I = \Sigma (\bar{I} + Ad^2)$$

$$I = 2\left[\frac{26 \times 2^3}{12} + 26 \times 2 \times (25-1)^2\right] +$$

$$\left[\frac{2 \times 50^3}{12} + 0\right]$$

$I_{xx} = 59938.66 + 20833.34$

$I = 80771.99 \text{ mm}^4$

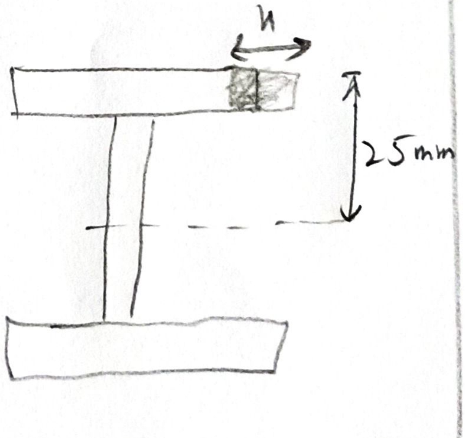
$\varepsilon \quad y = 25 \text{mm}$

Now for flange

$$F_f = \int_0^u q_f \, dx$$

$$= \int_0^u \frac{VQ}{I} \, du$$

$$= \int_0^u \frac{V \times 50\cancel{x}}{80772.9} \, dx$$



$$\frac{25V}{40386} \int_0^u u \, du$$

$Q = A \bar{y}$

$(2 \times u) \times 25$

$= 50u$

$$F_f = \frac{25V}{40386} \left| \frac{u^2}{2} \right|_0^u \rightarrow eq②$$

Now for $x = 20$ (from right side)

$Ff = \frac{25V}{40386}\left(\frac{20^2}{2} - 0\right)$

$$\boxed{Ff = 0.123V}$$

From left side

$x = 6$

eq ②

$$Ff = \frac{25V}{40386}\left[\frac{x^2}{2}\right]_0^6$$

$$Ff = \frac{25V}{40386}\left(\frac{6^2}{2} - 0\right)$$

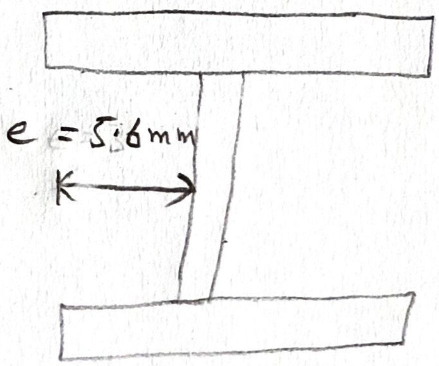
$$\boxed{Ff = 0.011V}$$

Now putting value in eq (i)

$$e = \frac{-0.011V \times 50 + 0.123 \times 50}{V}$$

$e = 5.6 \cancel{N}/\cancel{N}$

$e = 5.6\ mm$



Question No. 01

Part: "B" (CLO 2)

Given data:

Circumferential stress $= \sigma_c \le 6000psi$

$\gamma = 62.4\ lb/ft^3$

$D = 22ft$

Height $= 26ft$

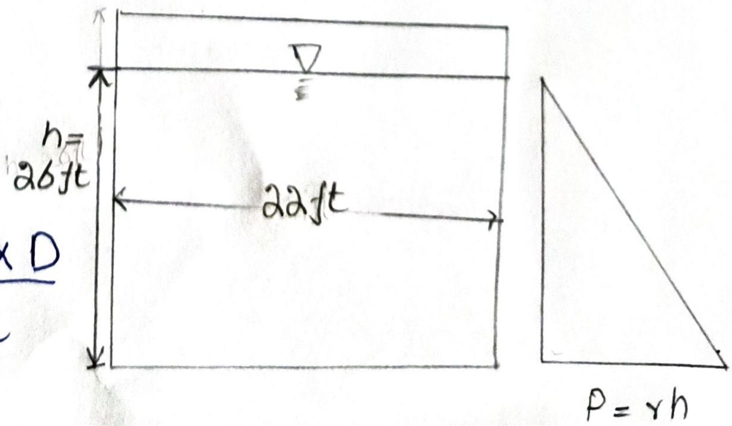
Requwird:

Determine the thickness of the wall of a water tank $= ?$

Solution:

As we know that the Pressure developed by water $= P = \gamma h$

$$\sigma_c = \frac{PD}{2t}$$



$$\sigma_c = \frac{\gamma h \times D}{2t}$$

$$t = \frac{\gamma h \times D}{2 \times \sigma_c}$$

$$t = \frac{(62.4 \times 26) \times 22}{2 \times (6000 \times 12^2)} = 0.02\ ft = 0.24\ inches$$

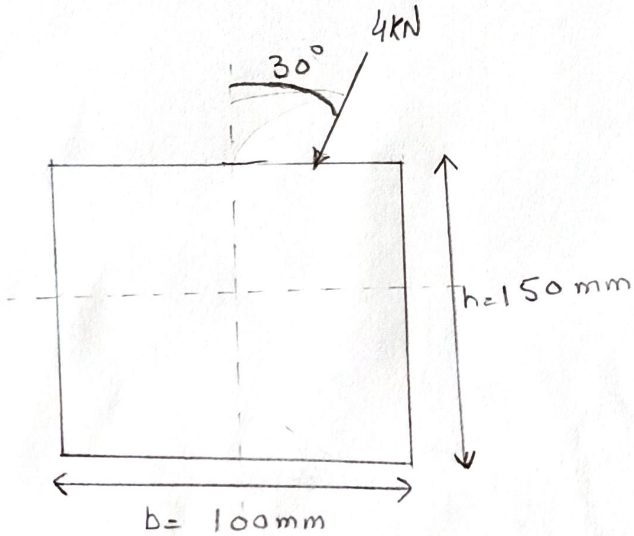
Question No: 02 Part (a) (CLO-3)

Given data:

$W = 4kN$

$L = 3m$

$\theta = 30^\circ$

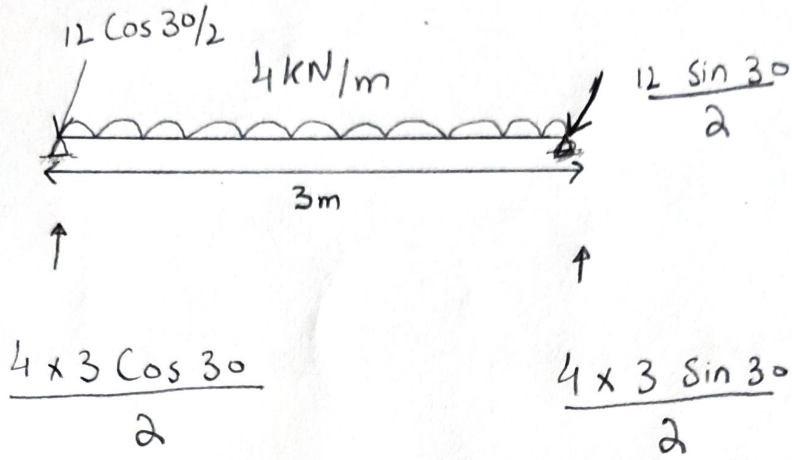


Required:

a) Max bending stresses at mid span = ?

b) Locate neutral axis = ?

Solution:



For UDL max moment Mmax at mid Section.

$$M_z = \frac{WL}{2} \times \frac{L}{4} = \frac{WL^2}{8}$$

$$M_z = \frac{4 \cos 30 \times 3^2}{8} = \boxed{3.9 \ kN/m}$$

Now for M_y

$$M_y = \frac{4 \sin 30 \times 3^2}{8}$$

$$M_y = 2.25 \ kN \cdot m \rightarrow \boxed{2.25 \ kN \cdot m}$$

$$I_y = \frac{0.150 \times 0.1^3}{12} = 1.25 \times 10^{-5} \, m^4$$

$$I_z = \frac{0.100 \times 0.150^3}{12} = 2.81 \times 10^{-5} \, m^4$$

As we know that total bending stress at mid span

$$\sigma_c = \frac{M_z}{I_z} y + \frac{M_y}{I_y} z$$

$y = 0.075 \, m$ $\quad z = 0.05 \, m$

$I_z = 2.81 \times 10^{-5} \, m^4, \; I_y = 1.25 \times 10^{-5} \, m^4$

$$\sigma_z = \frac{M_z \, y}{I_z}$$

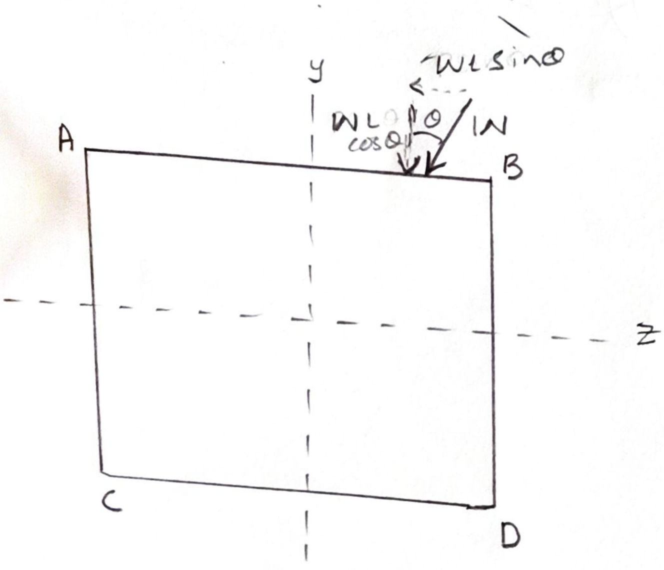
$$\sigma_z = \frac{3.9 \times 0.075}{2.81 \times 10^{-5}}$$

$$\boxed{\sigma_z = 10409.25 \; KN/m^2}$$

$$\sigma_y = \frac{M_y \, z}{I_y}$$

$$\sigma_y = \frac{2.25 \times 0.05}{1.25 \times 10^{-5}}$$

$$\sigma = 9000 \ KN/m^2$$



Maximum bending stress at the exterème fiber.

$$\sigma_A = -\sigma_z + +\sigma_y$$

$$\sigma_B = -\sigma_z + -\sigma_y$$

$$\sigma_c = +\sigma_z + +\sigma_y$$

$$\sigma_D = -\sigma_z + -\sigma_y$$

Note → $\sigma_z = 10409.25 \ KN/m^2$

$\sigma_y = 9000 \ KN/m^2$

Now

Max. Bending Stresses:

Compression

$\sigma_A = -10409.25 + 9000 = (-1409.25 \ KN/m^2)$

Compression

$\sigma_B = -10409.25 + (-9000) = (-1940.25 \ KN/m^2)$

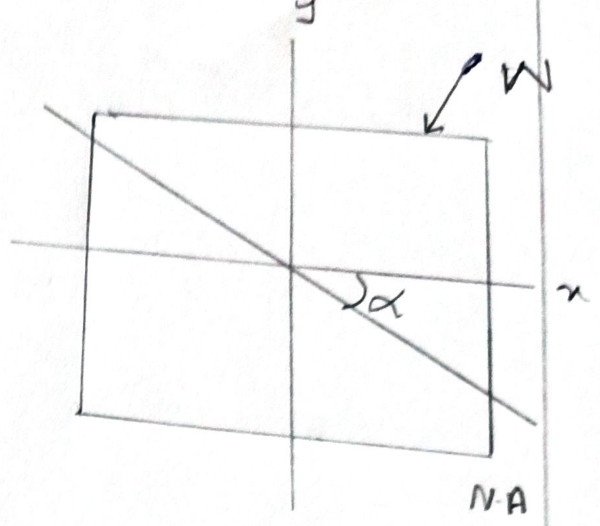
Tension

$\sigma_C = 10409.25 + 9000 = (1940.25 \ KN/m^2)$

Tension

$\sigma_D = 10409.25 + (-9000) = (1409.25 \ KN/m^2)$

Location of neutral axis:

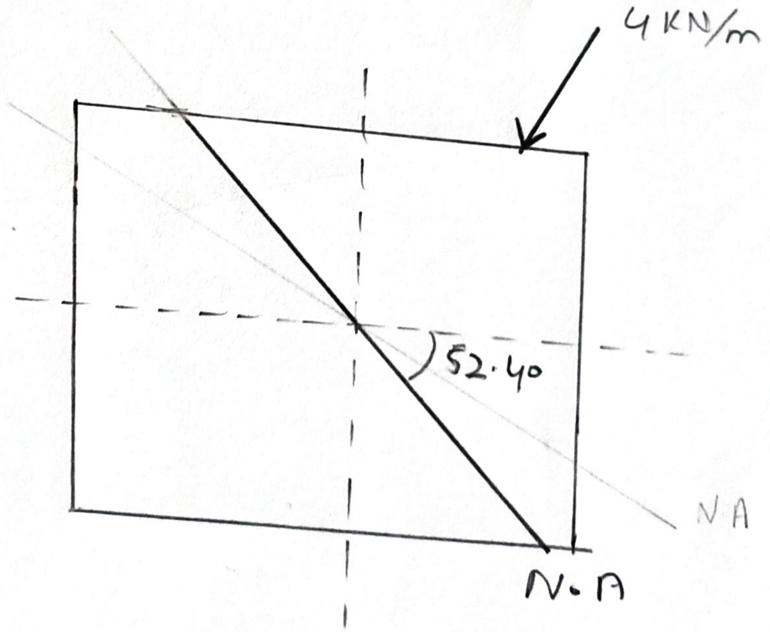


$$\tan\alpha = \frac{I_z}{I_y} \times \tan\theta$$

$$\tan\alpha = \frac{2.81\times10^{-5}}{1.25\times10^{-5}} \times \tan 30$$

$$\tan\alpha = 1.29$$

$$\boxed{\alpha = 52.40}$$



Question No. 02 Part (b) CLO. 3

Given data:

$\bar{y} = 3.07 in$

$x = 3 in$

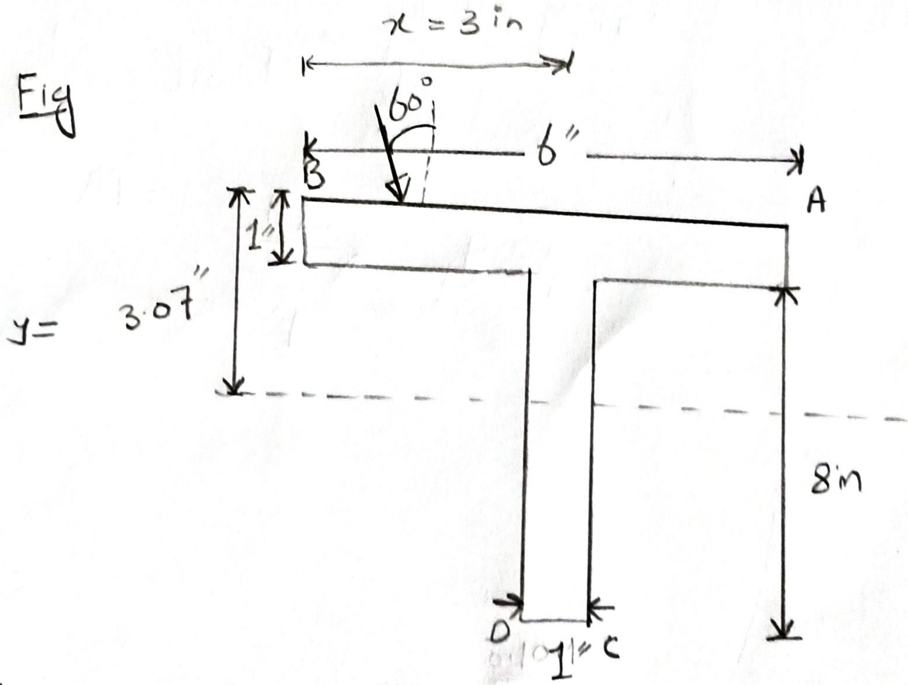
$I_x = 112.6 \ in^4$

$I_y = 18.7 \ in^4$

Compressive stress $\leq$ 12000 psi

Tensile stress $\leq$ 5000 Psi

Fig



Required:

Max load that will not overstress the beam?

Solution :

The maximum bending stresses occur at the mid section due to the maximum bending moment, so that the critical section is the mod section where the compressive and tensile stresses can exceed the limiting values.

" We also know that at any given section the maximum stress occur at the extereme fiber. For example point A, B, C, D.

We know that for point load at mid section is;

$$M = \frac{PL}{4}$$

$$M_x = \frac{P \cos 60 \times 16 \times 12}{4} = 24P''$$

$$My = \frac{P \sin 60 \times (16 \times 12)}{4}$$

$$\boxed{My = 41.57 P}$$

Stresses at point A, B, C and D

Point A :

$$6z = \frac{Mx}{Ix} y + \frac{My}{Iy} x$$

$$= -\frac{24 \times 3.07}{112.6} + \frac{41.57 \times 3}{18.7}$$

$$= -0.654 + 6.667$$

$$6z = 6.014 \text{ (Tension)}$$

σ Tension $\leq$ 5000 psi

$$\boxed{P = \frac{5000}{6.014} = 831.94 \text{ lb}}$$

For point B.

$$\sigma_B = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$$

$$\sigma_B = -0.564 + (-6.667)$$

$$\sigma_B = -7.231 \text{ (Compression)}$$

σ Compression $\leq$ 12000 psi

$$P = \frac{12000}{7.231}$$

$$\boxed{P = 1659.52}$$

So, Controlling value b/w A & B is

$$\boxed{831.94 \text{ lb}}$$

for point "C"

$\sigma_c = 0.654 + 6.667$

$\boxed{\sigma_c = 7.321 \rightarrow \text{Tension}}$

Σ_e Tenstion $\leq$ 5000 psi

$P = \dfrac{5000}{7.321}$

$P = 682.97$ lb

for point "D"

$\sigma_D = \cancel{-6} + 0.654 + (-6.667)$

$\cancel{\sigma_D} = \cancel{-7.321}$

$\sigma_D = -6.013$ ((compression)

Σ Compression ≤ 12000

$P = \dfrac{12000}{6.013}$

$P = 1995.67$ lb

So, Controlling value b/w C, D is

$\boxed{682.97 \text{ lb}}$

Q: No: 3 : CLO: 3

Given data:

$L = 10$ ft

$E = 10.3 \times 10^6$ psi

Factor of safty = 2

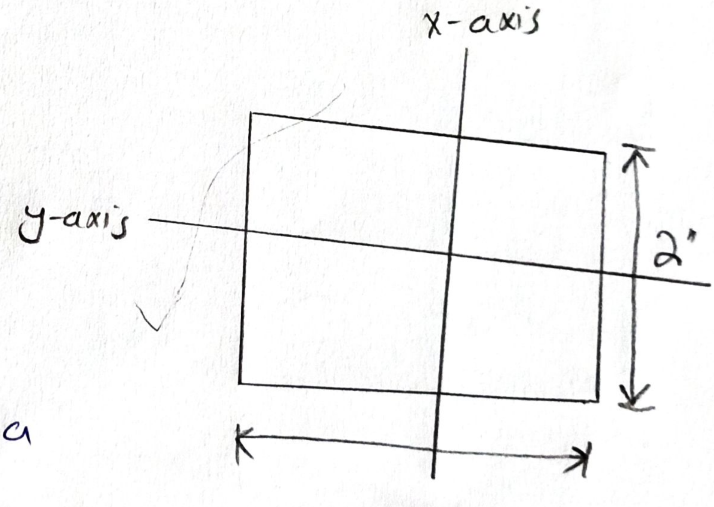
$n = 2$ (Center , braced)

Strut is a compression member act as a column.

Required:

P_{safe}?

Solution:



Case : 01

Struct act as a hinge column about an axis perpendicular to the 2in dimension.

$$I_x = \frac{bh^3}{12} \Rightarrow \frac{0.75 \times 2^3}{12}$$

$$I_x = 0.5 \text{ in}^4$$

As we know that

$$P_{cr} = \frac{n^2 E I \pi^2}{L_e^2}$$

For hinged ended column $L_e = L$

$$P_{cr} = \frac{(2)^2 \times (10.3 \times 10^6) \times (0.5)(3.14)^2}{(10 \times 12)^2}$$

$P_{cr} = 14104.70$ lb

Now safe:

$$P_{safe} = \frac{P_{cr}}{FOS} = \frac{14104.70 \text{ lb}}{2}$$

$$\boxed{P_{safe} = 7052.35 \text{ lb}}$$

Case: II

Structs or column acts as a fixed end column about an axis Parallel to 2in size.

So,

$$I_y = \cancel{\frac{bh^3}{12}} \quad \frac{hb^3}{12}$$

$$I_y = \frac{2 \times 0.75^3}{12}$$

$$I_y = 0.0703 \, in^4$$

$L_e = L/2$ (For fixed ended column)

Then;

$$P_{cr} = \frac{n^2 E I \pi^2}{L_e^2}$$

$$= \frac{(2)^2 \times (10.3\times10^6) \times (0.0703) \times (3.14)^2}{\left(\frac{10}{2} \times 12\right)^2}$$

$$\boxed{= 7932.48\ lb}$$

$P_{safe} = P_{cr}/FOS$

$= \frac{7932.48}{2}$

$$\boxed{= 3966.24\ lb}$$

"In both cases"

we will take smaller value of Psafe.

$P_{safe} = 3966.24 < 7052.35$

So, we will consider $\boxed{P_{safe} = 3966.24 lb}$